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PATENT  
Docket No.END920020013US1

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Appellant:	Burton, et al l.	Group Art Unit: 3719
Serial No.:	10/700,066	
Filed:	3 November 2003	
For:	<b>SPECULATIVE DATA MIRRORING APPARATUS METHOD AND SYSTEM</b>	
Examiner:	Brian R. Peugh	

**APPEAL BRIEF**

Mail Stop Appeal Brief-Patents  
Commissioner for Patents  
P.O. Box 1450  
Alexandria, VA 22313-1450

Dear Examiner:

The USPTO received Appellant's timely Notice of Appeal on September 5, 2006, which was filed in response to the Final Office Action mailed June 2, 2006. Appellant appeals the rejection of pending Claims 1-30.

This Brief is being filed under the provisions of 37 C.F.R. § 41.37. This Brief is timely as the Brief is being filed within two months of the filing of the notice of appeal. The filing fee set forth in 37 C.F.R. § 41.20(b)(2) of \$500.00 is submitted herewith. The Commissioner is hereby authorized to charge payment of any additional fees associated with this communication, or to credit any overpayment, to Deposit Account No. 09-0466.

## **1. REAL PARTY IN INTEREST**

The real party in interest is the assignee, International Business Machines Corporation.

## **2. RELATED APPEALS AND INTERFERENCES**

There are no related appeals, interferences, or judicial proceedings.

## **3. STATUS OF CLAIMS**

The Office Action cites the following art: the present application as Applicant Admitted Prior Art (hereinafter AAPA); U.S. Patent Number 4,965,719 to Shoens et al (hereinafter Shoens); U.S. Patent Number 5,742,792 to Yanai et al (hereinafter Yanai).

Claims 1-30 are pending in the case. Claims 1, 12, 14, 21, 22, and 24 are independent claims. Claims 1-11 are rejected under 35 USC § 112. Claims 14, 15, 17-25, and 27-30 are rejected under 35 USC § 103(a) as unpatentable over the combination of AAPA and Shoens. Claims 16 and 26 are rejected under 35 USC § 103(a) as unpatentable over the combination of AAPA, Shoens, and Yanai. Claims 12 and 13 are rejected under 35 USC § 103(a) as unpatentable over the combination of Shoens and Yanai.

To date, no Advisory Action has been mailed. Thus, the claims remain rejected as set forth in the final rejection. Appellant appeals the rejection of Claims 1-30.

## **4. STATUS OF AMENDMENTS**

No proposed amendments are pending.

## **5. SUMMARY OF CLAIMED SUBJECT MATTER**

The claimed subject matter deals with mirroring of data between a source storage controller and target storage controller. See published version of the application US patent Publication No. 2005/0097289 (hereinafter ‘289) Para. 16.

The problem addressed is overcoming the transmission latencies associated with synchronous operations in an asynchronous manner. See ‘289 Para. 16. The present invention improves the response times for synchronous operations in an asynchronous manner. See ‘289 Para. 16. Specifically, the claimed invention provides a mirror control module that initiates a

synchronous operation on a target volume and sends data for write operations to the target volume without waiting for feedback regarding the synchronous operation. See ‘289 Para. 18.

Embodiments of the present invention include a rollback log, a mirror control module, a first storage control module, a second storage control module, a first mirror control module, a second mirror control module, a method for speculative data mirroring, an alternative apparatus for speculative data mirroring, a source storage controller, a target storage controller, and an alternative method for speculative data mirroring.<sup>1</sup> See e.g. Claims 1, 12, 14, 21, 22, and 24.

Claim 1 presents an apparatus for speculative data mirroring. The apparatus comprises a rollback log configured to receive write data corresponding to at least one write operation to a storage region within a source volume. See ‘289 Para. 18, 59. The apparatus further comprises a mirror control module configured to initiate a synchronized operation on a corresponding storage region within a target volume and to send the write data corresponding to the at least one write operation to the target volume without waiting for feedback regarding the synchronous operation on the target volume. See ‘289 Para 18, 44, 57.

The following quotation of Claim 1 includes reference numerals and parenthetical references to representative examples of the elements and components recited in Claim 1 in compliance with 37 CFR 41.37(c)(1)(v).

1. An apparatus for speculative data mirroring, the apparatus comprising:  
a rollback log (See ‘289 element 216a, Fig. 2, Para. 18, 59) configured to receive write data, the  
write data corresponding to at least one write operation to a storage region within a source  
volume (See ‘289 element 130a, Fig. 2, Para. 18, 42);  
a mirror control module (See ‘289 element 214a, Fig. 2, Para. 18, 44, 57) configured to initiate a  
synchronized operation on a corresponding storage region within a target volume (See  
‘289 element 130b, Fig. 2, Para. 18, 42); and  
the mirror control module further configured to send the write data corresponding to the at least  
one write operation to the target volume without waiting for feedback regarding the  
synchronous operation on the target volume, wherein the synchronous operation must  
complete prior to writing the write data to the target volume. (See ‘289 Para. 18, 44, 57)

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<sup>1</sup> Although Appellant has summarized embodiments of the present invention, the present invention is defined by the claims themselves. Appellant’s summary is not intended to limit the scope of the claims or individual claim elements in complying with the appeal brief requirements under 37 C.F.R. § 41.37(c)(v).

Claim 12 presents an apparatus for bidirectional speculative data mirroring comprising a first storage control module and a second storage control module each respectively configured to conduct synchronous storage operations including lock operations on a respective first and second storage volume. See '289 Para. 84, 85. The apparatus includes first mirror control module configured to initiate a lock operation on a storage region within the second storage volume, the first mirror control module further configured to send data corresponding to at least one write operation to the first storage volume without waiting for feedback regarding the lock operation on the second storage volume. See '289 Para. 20. The apparatus includes second mirror control module configured to initiate a lock operation on a storage region within the first storage volume, the second mirror control module further configured to send data corresponding to at least one write operation to the second storage volume without waiting for feedback regarding the lock operation on the first storage volume. See '289 Para. 20, 84, 85.

The following quotation of Claim 12 includes reference numerals and parenthetical references to representative examples of the elements and components recited in Claim 12 in compliance with 37 CFR 41.37(c)(1)(v).

12. An apparatus for bidirectional speculative data mirroring, the apparatus comprising:
  - a first storage control module (See '289 element 212a, Figs. 2, 6, Para. 18, 50) configured to conduct synchronous storage operations including lock operations on a first storage volume (See '289 element 130a, Figs. 2, 6, Para. 50);
  - a second storage control module (See '289 element 212b, Figs. 2, 6, Para. 18, 50) configured to conduct synchronous storage operations including lock operations on a second storage volume (See '289 element 130, Figs. 2, 6, Para. 50);
  - a first mirror control module (See '289 element 214a, Figs. 2, 6, Para. 18, 44, 57) configured to initiate a lock operation on a storage region within the second storage volume, the first mirror control module further configured to send data corresponding to at least one write operation to the first storage volume without waiting for feedback regarding the lock operation on the second storage volume; and
  - a second mirror control module (See '289 element 214a, Figs. 2, 6, Para. 18, 44, 57) configured to initiate a lock operation on a storage region within the first storage volume, the second mirror control module further configured to send data corresponding to at least one write operation to the second storage volume without waiting for feedback regarding the lock operation on the first storage volume.

Claim 14 presents a method for speculative data mirroring that includes receiving data corresponding to one or more write operations to a storage region within a source volume. See ‘289 Para. 65. The method continues by inserting the data into a rollback log. See ‘289 Para. 59. The method then initiates a synchronous operation on a corresponding storage region within a target volume. See ‘289 Para 57. Finally, the method sends the data corresponding to the write operation to the target volume without waiting for feedback regarding the lock operation. See ‘289 Para. 58.

The following quotation of Claim 14 includes reference numerals and parenthetical references to representative examples of the elements and components recited in Claim 14 in compliance with 37 CFR 41.37(c)(1)(v).

14. A method for speculative data mirroring, the method comprising:  
inserting data into a rollback log, the data corresponding to a write operation to a storage region  
within a source volume;  
initiating a synchronous operation on a corresponding storage region within a target volume; and  
sending the data corresponding to the write operation to the target volume without waiting for  
feedback regarding the synchronous operation.

Claim 22 presents a system for speculative data mirroring that includes a source storage controller operably connected to a source volume. See ‘289 Para. 46, Fig. 2 elements 210a and 130a. The system also includes a target storage controller operably connected to a target volume. See ‘289 Para. 46, Fig. 2 elements 210b and 130b. A rollback log is configured to receive data corresponding to a write operation to a storage region within the source volume. See ‘289 Para. 59, Fig. 2 element 216a. A storage control module is operably connected to the target storage controller, the storage control module is configured to initiate a synchronous operation on a corresponding storage region within the target volume. See ‘289 Para. 48, Fig. 2 elements 212b.

The following quotation of Claim 22 includes reference numerals and parenthetical references to representative examples of the elements and components recited in Claim 22 in compliance with 37 CFR 41.37(c)(1)(v).

22. A system for speculative data mirroring, the system comprising:
- a source storage controller operably connected to a source volume; (See ‘289 Para. 46, Fig. 2 elements 210a and 130a)
  - a target storage controller operably connected to a target volume; (See ‘289 Para. 46, Fig. 2 elements 210b and 130b)
  - a rollback log configured to receive data corresponding to a write operation to a storage region within the source volume; (See ‘289 Para. 59, Fig. 2 element 216a.)
  - a storage control module operably connected to the target storage controller, the storage control module configured to initiate a synchronous operation on a corresponding storage region within the target volume. (See ‘289 Para. 48, Fig. 2 element 212b.)

Claim 24 presents a computer readable storage medium comprising a computer implemented method for speculative data mirroring that includes receiving data corresponding to a write operations into a rollback log, the write operation directed to a storage region within a source volume. See ‘289 Para. 59. The method continues by initiating a synchronous operation on a corresponding storage region within a target volume. See ‘289 Para 57. Finally, the method sends the data corresponding to the write operation to the target volume prior to receiving acknowledgement of the synchronous operation. See ‘289 Para. 55.

The following quotation of Claim 24 includes reference numerals and parenthetical references to representative examples of the elements and components recited in Claim 24 in compliance with 37 CFR 41.37(c)(1)(v).

24. A computer readable storage medium comprising computer readable program code for conducting a method of speculative data mirroring, method comprising:
- receiving into a rollback log data corresponding to a write operation, the write operation directed to a storage region within a source volume;
  - initiating a synchronous operation on a corresponding storage region within a target volume; and
  - sending the data corresponding to the write operation to the target volume prior to receiving acknowledgement of the synchronous operation.

Additionally, an embodiment of the present invention includes an apparatus claimed in means plus function format under 35 U.S.C. § 112, sixth paragraph. 37 CFR 41.37(c)(1)(v) requires examples of the structure, material, or acts corresponding to the means recited in Claim 21. Claim 21 presents a receiving means configured to receive data corresponding to a write operation to a storage region within a source volume. The storage control module 212 is one

example of a receiving means. See ‘289 element 212a, Figs. 2, 6, Para. 18, 50. The apparatus further comprises an initiating means configured to initiate a synchronous operation on a corresponding storage region within a target volume. The mirror control module 214a is one example of an initiating means. See ‘289 element 214a, Fig. 2, Para. 18, 44, 57. The apparatus also includes a messaging means configured to send the data corresponding to the write operation to the target volume without waiting for feedback regarding the synchronous operation. The mirror control module 214a is one example of a messaging means. See ‘289 element 214a, Fig. 2, Para. 18, 44, 57.

The following quotation of Claim 21, includes reference numerals and parenthetical references to representative examples of the elements and components recited in Claim 21 in compliance with 37 CFR 41.37(c)(1)(v).

21. An apparatus for speculative data mirroring, the apparatus comprising:  
receiving means configured to receive data corresponding to a write operation to a storage region  
within a source volume; (See ‘289 element 212a, Figs. 2, 6, Para. 18, 50)  
initiating means configured to initiate a synchronous operation on a corresponding storage region  
within a target volume; and (See ‘289 element 214a, Fig. 2, Para. 18, 44, 57)  
messaging means configured to send the data corresponding to the write operation to the target  
volume without waiting for feedback regarding the synchronous operation. (See ‘289  
element 214a, Fig. 2, Para. 18, 44, 57)

The claimed invention provides a system, apparatus, and method that expedites data mirroring by not waiting for feedback of a synchronous operation before continuing with storing and mirroring of data associated with the synchronous operation. See ‘289 Para. 44. The invention further provides that if an error in the synchronous operation does occur that the associated operations can complete. See ‘289 Para. 43.

## **6. GROUNDS OF REJECTION TO BE REVIEWED ON APPEAL**

**I. Whether the Examiner properly rejected Claims 1-11 under 35 U.S.C. §112, first paragraph for failing to comply with the written description requirement?**

**II. Whether the Examiner properly rejected Claims 14, 15, 17-25 and 27-30 under 35 U.S.C. §103(a) as obvious in view of AAPA and Shoens?**

**III. Whether the Examiner properly rejected Claims 16 and 26 under 35 U.S.C. §103(a) as obvious in view of AAPA, Shoens, and Yanai?**

**IV. Whether the Examiner properly rejected Claims 12 and 13 under 35 U.S.C. §103(a) as obvious in view of Yanai and Shoens?**

**V. Whether Claim 11 is properly rejected under 35 U.S.C. §103(a) as obvious in view of Yanai, Shoens and Testardi?**

## **7. ARGUMENT**

### **I. The rejection of Claims 1-11 under 35 U.S.C. §112, first paragraph is improper because the law does not require a word-for-word correlation between the terms in the claims and the teachings in the specification to comply with the written description requirement.**

Summary of the Examiner arguments.

[001] The Examiner rejects Claims 1-11 under 35 USC § 112 for failure to comply with the written description requirement. Specifically, the Examiner indicates that no support in the Specification was found for the limitation from Claim 1 “that the synchronous operation must complete prior to writing data to the target volume.” The Examiner states that the entire specification contains no support for this limitation. The Examiner suggests that the amendments to Claim 4 are also unsupported. Specifically, the Examiner states that “paragraph 18 of the Specification recites that the lock command is performed in conjunction with the lock operation, not that the lock operation comprises the lock command.” Finally, the Examiner points to amended Claim 6 and indicates a lack of written description support because “there is no teaching in paragraph 67, or Applicant’s Specification as a whole, for the newly amended claim subject matter.”

Response.

[002] Appellants respectfully reaffirm the arguments raised against the rejection of Claims 1-11 under 35 USC §112 set forth in the response mailed July 28, 2006. Furthermore, Appellants submit that the Examiner’s rationale for maintaining the rejection misstates the teachings in the Specification. Finally, Appellants submit that the Examiner has improperly maintained this rejection with respect to Claim 6 because the Examiner has referenced a different published version of the specification.

The statute

[003] 35 USC §112, first paragraph states:

“The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same, and shall set forth the best mode contemplated by the inventor of carrying out his invention.”

Consequently, the written description provided is to be examined with respect to the knowledge, skills, and capabilities of a “person skilled in the art to which it[the invention] pertains.” Appellants submit that with respect to the present invention, one of skill in the art is a person trained in the art of computer science, electrical engineering, and software engineering.

Regarding Claim 1

[004] Appellants submit that one of skill in the art reading the Specification, as well as the specific portions highlighted in conjunction with the Appellant’s last response, would readily grasp the concepts taught so as to make and use the invention set forth in amended Claim 1.

Amended Claim 1 recites a rollback log and a mirror control module that initiates a synchronous operation wherein “the synchronous operation must complete prior to writing the write data to the target volume.”

[005] Appellants submit that the Examiner seems to be maintaining the rejection strictly on the grounds that word-for-word support is not present in the Specification to explain a term and/or attribute that is already present, is well known to those in the art, and is at least inherent in the present disclosure. Appellants submit that such a word-for-word support requirement is not the legal standard and is improper.

[006] The words of the claim must be given their “plain meaning” unless they are defined in the specification. MPEP §2111.01. “[The] meaning of words used in a claim is not construed in a “lexicographical vacuum, but in the context of the specification and drawings.”

*Toro Co. v. White Consolidated Industries Inc.*, 199 F.3d 1295, 1301, 53 USPQ2d 1065, 1069 (Fed. Cir. 1999). MPEP §2106. According to the Manual of Patent Examining Procedure, “Office personnel must rely on the applicant’s disclosure to properly determine the meaning of

terms used in the claims.” MPEP § 2106. *Markman v. Westview Instruments*, 52 F.3d 967, 980, 34 USPQ2d 1321, 1330 (Fed. Cir.) (*en banc*), *aff ’d*, U.S. , 116 S. Ct. 1384 (1996).

[007] Here, the Examiner seems to reject the amendments to Claims 1, 4, and 6 without regard to Applicant’s disclosure, the knowledge of those of skill in the art, or the inherent meaning of the teachings provided in the disclosure.

Present in the Specification.

[008] In the response mailed July 28, 2006, Appellants reviewed numerous locations of teachings in the Specification regarding a synchronous operation such as a lock operation and how this operation precedes the writing of data. Appellants submit that, in view of the consistency amendments requested by the Examiner in the Office Action mailed December 16, 2005, the terms synchronous operation and lock operation are synonymous. See published version of the present application, U.S. Patent Publication No. 2005/0097289 hereinafter “Burton)” ¶18 states that the “synchronous operation may be a lock operation.”

[009] Those of skill in the art understand that in computer systems that allow for concurrent access to storage devices, lock operations are commonly used to ensure data consistency and integrity. Locks in the computer science art are defined as “a mechanism for enforcing limits on access to a resource in an environment where there are many threads of execution. Locks are one way of enforcing concurrency control policies” See [http://en.wikipedia.org/wiki /Lock\\_%28computer\\_science%29](http://en.wikipedia.org/wiki /Lock_%28computer_science%29), Attachment A. If the access to a resource, in the wikipedia definition, is writing of write data to a target volume, one of skill in the art understands that this limitation means that only the process or user holding the lock will be able to write data. Consequently, a user or process requesting a lock will be unable to write data until the operation to obtain the lock has completed.

[010] Burton ¶26 explains that the sending of data is halted as a result of a lock command failing. This further supports the principle that the lock is requisite prior to the actual writing of data to the target volume. One aspect of the invention is to allow the transmission of data to the target volume prior to the actual granting of the lock on the target volume. However, Claim 1 and all parts of the specification teach that transmitted data cannot be written to the target volume without successfully locking a region on the target volume.

[011] Burton ¶¶67 and 69 further support the temporal sequencing of Claim 1:

¶67 .... If the operation such as a lock operation has been granted, the method proceeds to the conduct associated operations step 440. Otherwise, the method loops to the operation granted test 430. (quoted as amended in last Office Action Response).

¶69 ... The conduct associated operations step 440 performs operations associated with the granted operations .... For example, one or more write operations associated with a lock operation may be performed in conjunction with the conduct associated operations step 440...

[012] Appellants further submit that Original Claim 9 makes it clear that the transmission of data to the target volume should halt in response to the rejection of a lock command. As such, the original Claims support the limitation that the lock command is a prerequisite to the writing of data on the target volume.

#### Known to those in the Art

[013] Appellants have explained where the Applicant's disclosure teaches those of skill in the art regarding the requirement that a synchronous operation complete prior to writing data to the target volume. Appellants note that the Examiner may have been unable to locate the referenced support because the Examiner may have been referring to a different version of the printed specification. Appellants note that all references to support above are to the published version of the application U.S. Patent Publication No. 2005/0097289 (defined above as Burton).

[014] Factors that may be considered in determining level of ordinary skill in the art include (1) the educational level of the inventor; (2) type of problems encountered in the art; (3) prior art solutions to those problems; (4) rapidity with which innovations are made; (5) sophistication of the technology; and (6) educational level of active workers in the field."

*Environmental Designs, Ltd. v. Union Oil Co.*, 713 F.2d 693, 696, 218 USPQ 865, 868 (Fed. Cir. 1983), cert. denied, 464 U.S. 1043 (1984). MPEP §2141.03.

[015] Here, the art is computer science, electrical engineering, and software engineering. The education level of the inventors is at least a college degree in computer science and/or electrical engineering. The types of problems have to do with efficiency in mirroring data between a source storage volume and a target storage volume. There are no prior art solutions to

the problem relating to write operations and synchronous operations (locks) relating thereto. The speed at which innovations are developed is fairly rapid as data storage, maintenance and recovery are often high priorities. The technology is quite complex and requires workers with a strong understanding of storage devices, technologies and protocols. Finally, the educational level of workers in the field is at least a college degree in the art.

[016] Given these factors, the Appellants submit that one of skill in the art of computer science, electrical engineering, and software engineering within the field of data storage would be clearly understand that synchronous operations such as obtaining a lock on a storage device must complete prior to performing the write operation.

#### Inherently disclosed

[017] “By disclosing in a patent application a device that inherently performs a function or has a property, operates according to a theory or has an advantage, a patent application necessarily discloses that function, theory or advantage, even though it says nothing explicit concerning it. The application may later be amended to recite the function, theory or advantage without introducing prohibited new matter. *In re Reynolds*, 443 F.2d 384, 170 USPQ 94 (CCPA 1971); *In re Smythe*, 480 F. 2d 1376, 178 USPQ 279 (CCPA 1973). “To establish inherency, the extrinsic evidence ‘must make clear that the missing descriptive matter is necessarily present in the thing described in the reference, and that it would be so recognized by persons of ordinary skill.’” MPEP §2163.07(a)

[018] Appellants submit that if the board disagrees that the subject matter is not already present or within the knowledge of those of skill in the art, the board should rule that the limitations are inherent for synchronous operations to obtain a lock for writing of data to a storage device. Burton ¶67 discloses one example that illustrates the inherent requirement that a synchronous operation obtain a lock prior to writing data. ¶67 should be read in context with ¶¶64-71 which describe the flow chart of Figure 4. ¶ 67 describes the operation granted test 430 which repeatedly tests to determine if an operation is completed. If not, the operation granted test 430 waits and continues to test until the operation is completed. The test 430 is performed in relation to a received command. The received command is a lock command. See Burton ¶65.

[019] The loop of operation granted test 430 teaches that the method 400 does not continue until the operation is completed. The operation is the obtaining of a lock. Once the operation is granted, the lock is granted, associated operations are performed. Burton ¶69 states "one or more write operations associated with a lock operation may be performed in conjunction with the conduct associated operations step 440." Appellants submit that both those skilled in the art and those with no formal training in the art readily conclude from these teachings that the operation of obtaining the lock must complete before the operations of writing data can be performed.

[020] Therefore, making this inherent attribute clear by the submitted amendments does not violate the written description requirements of 35 USC §112, first paragraph. To maintain the Examiner's position is contrary to the disclosure and improper. Appellants submit that if the Examiner objects to the term "synchronous operation" Appellants are willing to amend this term to "lock operation" to put this case in better condition for appeal or allowance.

#### Regarding Claim 4

[021] The Examiner submits that "a lock operation comprising a lock command" is not supported in ¶18. The Examiner then references ¶18 of the filed application. Appellants submit that there is confusion with regard to which portion of the application includes the cited support. Appellants apologize for the confusion. Burton ¶24 states: "Certain embodiments of initiating a lock operation may include sending a lock command to the target volume." See ¶ 22 of the filed application. Appellants submit that the amendment is clearly supported because "comprising" is an open term similar to "include" in the cited support. Therefore, the amendment "a lock operation comprising a lock command" is supported by Burton ¶24 "...a lock operation may include [comprise] sending a lock command." Therefore, Appellants request that the rejection under §112, first paragraph of Claim 4 be overruled.

#### Regarding Claim 6

[022] Again, Appellants submit that there is confusion with regard to which portion of the application includes the cited support. Appellants apologize for the confusion. The Applicant's response mailed March 15, 2006 does state "as supported by the last sentence of ¶67

of the published version of the specification and Figure 4.” The Examiners seems to have referenced the filed application at paragraph 67. Appellants submit that proper support is provided in U.S. Patent Publication No. 2005/0097289 (defined herein as Burton) paragraph 67. Furthermore, the overall concept of repeating is disclosed in Burton ¶¶64-69 which are specifically explained above.

[023] Appellants submit that the Office Action has improperly made a broad sweeping generalization that “there is no teaching in paragraph 67, or Applicant’s Specification as a whole, for the newly amended claim subject matter.” The Appellants submit that this broad generalization is incorrect and improper.

**II. The rejection of Claims 14, 15, 17-25 and 27-30 under 35 U.S.C. §103(a) as obvious is improper because the AAPA and Shoens fail to teach each element of the recited claims.**

Summary of the Examiner arguments.

[024] The Examiner rejects Claims 14-15, 17-25, and 27-30 under 35 USC § 103(a) as unpatentable over the combination of AAPA and Shoens. The Examiner relies heavily on AAPA and on Shoens for the concept of not waiting for feedback regarding the synchronous operation. In the final office action mailed June 2, 2006, the Examiner indicates that the Appellants arguments are unpersuasive. The Examiner then responds to various paragraphs of the Applicant’s arguments.

Response.

[025] Appellants respectfully reaffirm the arguments raised against the rejection of Claims 14, 15, 17-25, and 27-30 under 35 USC §103(a) set forth in the response mailed July 28, 2006. Appellants incorporate the arguments raised in the March 15, 2006 Office Action Response by reference. Furthermore, Appellants submit that the Examiner’s reluctance to give proper weight and credit to each word of the Claims is improper and unjustified. Appellants submit that the Examiner takes the position in rejections under 35 USC §112 that each amendment must have word-for-word support in the claims (explained above as improper) and then reverses position and requires no word-for-word correlation under 35 USC §103 (also

improper as explained below) when identifying elements of the prior art as obvious in view of the claimed element terms.

#### The legal requirements

[026] The legal requirements for a *prima facie* case of obviousness are set forth in the Appellant's response mailed March 15, 2006, page 15, ¶19.

#### Claim 14

[027] Claim 14 recites:

14. (Currently Amended) A method for speculative data mirroring, the method comprising:  
inserting data into a **rollback log**, the data corresponding to a write operation to a storage region within a source volume;  
initiating a synchronous operation on a corresponding storage region within a target volume; and  
**sending** the data corresponding to the **write operation** to the target volume **without waiting for feedback** regarding the synchronous operation.

[028] Appellants maintain the position that neither AAPA nor Shoens teach or disclose each element of Claim 14. Claim 14 is representative of the other rejected independent Claims 21, 22, and 24.

[029] Specifically, AAPA fails to teach or disclose a rollback log or the “sending” of a “write operation...without waiting for feedback...” (a concept referred to as “prospective writes” in earlier responses for clarity). Appellants raised this argument and support therefore in the response mailed March 15, 2006, on pages 16-20, paragraphs 20-32. In those paragraphs, Appellants explained that a buffer as disclosed by the Applicant and a rollback log are fundamentally different. Appellants also captured the concept of “sending” of a “write operation...without waiting for feedback...” as a “prospective write” to simply and clarify the explanation of the argument. Appellants refer the board to the response mailed March 15, 2006, on pages 16-20, paragraphs 20-32 for a detailed explanation of the Appellants arguments.

[030] In the Final Office Action mailed June 2, 2006, the Examiner agrees with the Appellants definition of a rollback log as a tool used for backing out data already written to a

hard drive. See Final Office Action mailed June 2, 2006, page 19, last paragraph. Appellants provided the definition that:

“To increase efficiency, Applicants teach writing to a rollback log associated with a source storage controller to allow backing the write out of the source if the requested lock fails. *Burton*, Claims 1, 7-9; *Burton* ¶¶ 57, 62. The entries of the rollback log define how to undo the write. Increased efficiency is achieved by prospectively writing data to the mirrored volume, since a mirrored volume will frequently grant the lock of a target storage region.” See Applicant response mailed March 15, 2006, ¶24.

[031] The Examiner notes that the claim language fails to include a specific definitional limitation on the term “rollback log.” The Examiner states: “The Examiner disagrees. Limitations directed towards backing out data had not been attributed to claim 1.” See Final Office Action mailed June 2, 2006 page 19, last paragraph.

[032] Appellants appreciate the Examiner’s invitation to include definitional language regarding a rollback log in the independent claims. However, Appellants declined to accept that invitation. Appellants submit that such a clarification is not necessary since the term “rollback log” already embodies this concept. Instead, Appellants request that the board give all of the claim terms their proper scope and interpretation in view of the specification and level of ordinary skill in the art that the time the invention was made.

[033] “All words in a claim must be considered in judging the patentability of that claim against the prior art.” *In re Wilson*, 424 F.2d 1382, 1385, 165 USPQ 494, 496 (CCPA 1970). MPEP §2143.03. “[The] meaning of words used in a claim is not construed in a “lexicographical vacuum, but in the context of the specification and drawings.” *Toro Co. v. White Consolidated Industries Inc.*, 199 F.3d 1295, 1301, 53 USPQ2d 1065, 1069 (Fed. Cir. 1999). MPEP §2106. “Office personnel must rely on the applicant’s disclosure to properly determine the meaning of terms used in the claims.” MPEP § 2106. *Markman v. Westview Instruments*, 52 F.3d 967, 980, 34 USPQ2d 1321, 1330 (Fed. Cir.) (*en banc*), *aff ’d*, U.S. , 116 S. Ct. 1384 (1996).

[034] Here, the term in question is “rollback log.” Appellants have explained using intrinsic evidence that the term “rollback log” is a term specifically chosen for use in the claims due to its well known and specific meaning in the art. See *Burton* ¶¶57, 62, Applicant response mailed March 15, 2006, ¶24. The phrase “rollback log” is made of the term “rollback” which means to return data such as a database back to its original state and “log” which means to record

sequential input, typically associated with time. See Attachment B “Rollback (Data Management)” and Attachment C “Data Logging.”

[035] Appellants submit that to require amendment of Claim 14 to include a definition of rollback log, implies that the term is not clear on its face or is limited in some way beyond its normal definition. Appellants submit that such is not the case here. Furthermore, the limiting of the term “rollback log” is not necessary for patentability.

[036] Appellants further submit that no word-for-word correlation exists between the term “rollback log” and “buffer” disclosed in Burton ¶12. This is precisely because these two terms represent different concepts that are not within the scope of each other. As explained, a “rollback log” is for undoing or re-doing previous operations. Consequently, rollback logs include metadata needed to do that such as timestamp information. In contrast, a buffer is simply temporary storage used to hold data that is awaiting transmission on the slower transmission link. See Burton ¶12.

[037] Appellants submit that if the Applicants believed the teaching of a buffer used for queuing data awaiting transmission was included within the scope of the claim language of Claim 14, Applicants would have used the term “buffer.” Buffer is certainly a much broader term than “rollback log.” Applicants would not have gone to the trouble of using and defining a term different than buffer. However, it is the fact that these terms are different that supports Appellant’s position that AAPA fails to teach the concept of a “rollback log.”

[038] Appellants maintain that Shoens fails to teach or disclose the concept of “sending” of a “write operation...without waiting for feedback...” characterized as a “prospective write” to simply and clarify the explanation of the argument. These arguments are laid out in the response mailed March 15, 2006, on page 17, paragraphs 22-26, (included herein for convenience).

Initially, it may be instructive to review the cited art and the present invention. Shoens discloses a control structure to “control concurrent access to data resources by multiple users.” Shoens col. 2, ll. 55-53. Shoens teaches how to maintain coherency among copies of a block of data. Shoens Abstract; col. 4, ll. 56-67. Shoens allows multiple read accesses, but only a single write lock. Shoens col. 3, ll. 6-14. Shoens uses a lock manager that allows **READ** requests to overlap with a write lock request (referred to as an update lock in Shoens and referred to throughout this OAR as a write lock request). Shoens col. 3, ll. 6-14;

col. 4, ll. 61-66. However, Shoens does not disclose a method that allows multiple concurrent writes or that allows prospective writes prior to the granting of a write lock. Shoens states that “the key aspect of implementing asynchronous lock requests is that the lock request processing must be done against the state of lock tables some time in the past.” Shoens col. 5, ll. 33-35. Shoens relies on time-stamped lock requests and lock grants to determine when a lock should be validated or invalidated. Shoens col. 5, ll. 35-40.

Shoens’ stated objective is to “control concurrent access to data resources by multiple users” and “efficiently support record locking and buffer invalidation in N-way data sharing and to continue notification of resource change and adjustments to other processes holding locks in a transaction oriented environment.” Shoens col. 2, ll. 55-68. While Shoens does seek to increase throughput, Shoens’ method of increasing throughput relies on concurrent **prospective reads** in conjunction with a single update lock followed by notification to owners copies of read blocks that have been subsequently modified by a granted update lock. Shoens col. 2, 56-68; col. 3, ll. 8-18; col. 4, ll. 59-68. Shoens does not teach or suggest sending multiple writes or prospective writes to a storage system. Shoens does not use rollback logs for the reads or for writes. Rather, Shoens notifies owners of copies of a locked data block that the prospectively read block is invalid. Shoens col. 2, ll. 64-68.

Applicants disclose an apparatus, method, and system to increase throughput of writes to mirrored storage volumes that rely on writes to a **rollback log** in combination with **prospective writes** to a target volume prior to receiving a write lock for the target volume. Burton ¶13, Claim 1. To increase efficiency, Applicants teach writing to a rollback log associated with a source storage controller to allow backing the write out of the source if the requested lock fails. Burton, Claims 1, 7-9; Burton ¶¶ 57, 62. The entries of the rollback log define how to undo the write. Increased efficiency is achieved by prospectively writing data to the mirrored volume, since a mirrored volume will frequently grant the lock of a target storage region. The present invention does not rely on a synchronized logical clock or a means for encoding past states of held locks. Shoens states that it depends on “a synchronized logical clock [and] a means of encoding the past states of held locks...” Shoens col. 5, ll. 52-56.

Applicants have amended Claim 1 to emphasize the write operation. According to Amended Claim 1, the synchronous operation (the request for the lock) must complete prior to writing any data to the target volume. This is supported by ¶69 and Figure 4 element 440, showing that the associated operation or write completes after the lock has been acquired. In contrast, Shoens allows the read operation to succeed before the granting of the lock. See Shoens col. 5, ll. 33-40. When a read is invalidated under Shoens, the resource lock manager sends

notifications to prospective readers of a buffer that the previously read buffer is now invalid and must be discarded. Shoens col. 3, ll. 22-30.

Thus, under the present invention, a prospective write is held in reserve until a lock is obtained. However, in Shoens, a prospective read is allowed to succeed and invalidated after the fact depending on the modifications by a write lock holder.

[039] The Examiner responds by noting that the terms “speculative data mirroring,” “prospective writes,” or “speculative writes operations” are only mentioned briefly in the preamble of Claim 14. See Final Office Action page 19.

[040] Appellants submit that there is no need or requirement for Claim 14 to include use of a term such as “speculative data mirroring,” “prospective writes,” or “speculative writes operations” where the concept is adequately spelled out in the claim language. Specifically Claim 14 recites “sending the data corresponding to the write operation to the target volume without waiting for feedback regarding the synchronous operation.” Appellants note that arguments submitted thus far in prosecution clearly indicate where Shoens fails to teach or disclose this element. Consequently, since each claim term is to be considered in the examination, the “sending” element is nonobvious and distinguishes Claim 14 over the art of record.

[041] Appellants submit that the Examiner has conceded to this fact in that the Examiner has invited a claim amendment that places “speculative data mirroring,” “prospective writes,” or “speculative writes operations” in the body of the claim. If the Examiner maintained that Shoens or AAPA teach “prospective writes” no such invitation would be made.

[042] The term “prospective writes” is simply a short hand phrase for the more detailed element set forth in the claims such as Claim 14 that recites “sending the data corresponding to the write operation to the target volume without waiting for feedback regarding the synchronous operation.”

[043] Appellants submit that because AAPA and Shoens fail to teach or describe the element ““sending the data corresponding to the write operation to the target volume without waiting for feedback regarding the synchronous operation” Claim 14 is allowable.

Claims 15, 17-25, and 27-30

[044] Claims 21, 22, and 24 include the missing elements of AAPA and Shoens discussed above in relation to Claim 14, namely a “rollback log” and “sending the data corresponding to the write operation to the target volume without waiting for feedback regarding the synchronous operation.” Therefore, Claims 21, 22, and 24 are allowable for at least the same reasons as Claim 14.

[045] Claim 17 recites “inserting a lock command into the rollback log.” Appellants submit that this element further distinguished the recited claims for the AAPA. The AAPA teaches inserting of data corresponding to read and write operations in a buffer for asynchronous replication. Burton ¶12. However, Burton ¶12 also teaches that operations such as lock operations require synchronization for proper completion. The operation using the “buffer” of Burton is an asynchronous operation. Therefore, the “buffer” disclosed can not be used to hold lock commands. AAPA says nothing about synchronous operations that involve lock commands and the buffer. Instead, as part of the description of the recited Claim 17, Burton teaches that the rollback log stores lock commands. See Burton ¶ 19. Therefore, once again, the “rollback log” and “buffer” are fundamentally different.

[046] Claim 15, 17-20, 23, 25, and 27-30 depend from Claims 14, 22, and 24 and are allowable for at least the same reasons as the independent claims.

[047] Finally, no motivation to combine the AAPA with Shoens exists. While Shoens seeks to increase throughput, the citation from the Shoens Abstract does not give any suggestion to increase throughput through the use of prospective writes or through the use of a rollback log.

[048] In fact, Shoens teaches away from the use of prospective writes, stating that Shoens relates to prospective reads. Shoens col. 3, ll. 5-18; col. 4, ll. 59-58; col. 5, ll. 4-7. Those of skill in the art recognize that a read is a non-destructive operation and a write is a destructive operation. Consequently, even a teaching in Shoens of prospective reads does not motivate or encourage one in the art to produce the claimed invention because of the distinct difference between reading and writing and its effects on the data. More specifically, prospective writes as disclosed in the claimed invention require a way to undo the operation, which the recited rollback log provides.

[049] The stated desire to make an invention better does not provide the required suggestion, incentive, and motivation to **combine** two references. “When the combination of the two references create an unworkable invention, no motivation to combine exists. Obviousness can only be established by combining or modifying the teachings of the prior art to produce the claimed invention where there is some teaching, suggestion, or motivation to do so found either explicitly or implicitly in the references themselves or in the knowledge generally available to one of ordinary skill in the art.

[050] Therefore, Appellants submit that Claims 14-15, 17-25, and 27-30 are nonobvious under 35 USC § 103(a) because AAPA and Shoens fail to teach each element recited in these claims. AAPA and Shoens fail to teach or disclose a rollback log or the “sending” of a “write operation...without waiting for feedback...” ( a concept referred to as “prospective writes” in earlier responses for clarity). Appellants request that the board give proper weight and credit to each word of Claims 14-15, 17-25, and 27-30 and give the words their proper meaning. Even though the claims may not list out all the further definitions of the terms as the Examiner would like, the claim terms currently pending meet the patentability requirements and are distinct from the art of record.

**III. The rejection of Claims 16 and 26 under 35 U.S.C. §103(a) as obvious in view of AAPA, Shoens, and Yanai is improper because AAPA, Shoens, and Yanai fail to teach each element of Claims 16 and 26.**

Summary of the Examiner arguments.

[051] The Examiner rejects Claims 16 and 26 under 35 USC § 103(a) as unpatentable over the combination of AAPA, Shoens and Yanai. The Examiner relies heavily on Yanai in support for the elements of Claims 16 and 26. In the final office action mailed June 2, 2006, the Examiner indicates that the Appellants arguments are unpersuasive but does not specifically address Claims 16 and 26.

## Response

[052] Appellants submit that Claims 16 and 26 are allowable for at least the same reasons as the independent claims 1 and 24 upon which they depend. In addition, as discussed with respect to Claim 14, the cited AAPA and Shoens do not disclose or teach a rollback log. The AAPA and Shoens also do not teach or disclose the sending of prospective write data prior to the reception of a lock on a target volume.

[053] Yanai discloses a system for data mirroring between two storage systems. At column 9, ll. 60-col. 10, l. 2, Yanai teaches a method that requires a source volume to block operation until an acknowledgement from a target volume. This teaching is inapposite with the concept of sending prospective write data prior to, or without, receiving a lock on a target volume as recited in Claims 1, 14, and 24. Consequently, Yanai teaches away from the present invention and is not a valid reference to support a *prima facie* case of obviousness.

## IV. The rejection of Claims 12 and 13 under 35 U.S.C. §103(a) as obvious in view of Yanai and Shoens is improper where Yanai and Shoens fail to teach or disclose bidirectional speculative data mirroring.

Summary of the Examiner arguments.

[054] The Examiner rejects Claims 12 and 13 under 35 USC § 103(a) as unpatentable over the combination of Shoens and Yanai. The Examiner relies heavily on Yanai in support for the elements of Claims 12 and 13.

## Response

[055] As discussed with respect to Claims 1, 14 and 24 Shoens and Yanai fail to disclose or teach a rollback log. Yanai and Shoens also do not teach or disclose the sending of prospective write data prior to the reception of a lock on a target volume. Claim 12 includes the main elements of claims 1, 14 and 24. To establish a *prima facie* case of obviousness, the Office Action must cite references that teach all of the elements of the claimed invention. In the absence of such a *prima facie* case, Applicants submit that Claims 12 and 13 are allowable.

[056] In addition, Claim 12 recites further limitations which distinguish it from the prior art of record. Specifically, Claim 12 recites first and second storage volumes, first and second storage control modules, and a first and second mirror control module. See Claim 12.

12. An apparatus for bidirectional speculative data mirroring, the apparatus comprising:

a first storage control module configured to conduct synchronous storage operations including lock operations on a first storage volume;

a second storage control module configured to conduct synchronous storage operations including lock operations on a second storage volume;

a first mirror control module configured to initiate a lock operation on a storage region within the second storage volume, the first mirror control module further configured to send data corresponding to at least one write operation to the first storage volume without waiting for feedback regarding the lock operation on the second storage volume; and

a second mirror control module configured to initiate a lock operation on a storage region within the first storage volume, the second mirror control module further configured to send data corresponding to at least one write operation to the second storage volume without waiting for feedback regarding the lock operation on the first storage volume.

[057] Appellants submit that even assuming *arguendo* that the prior art reference taught or disclosed speculative data mirroring in one direction from a source to a target, there is no teaching in AAPA, Shoens, Yanai, or Testardi for bidirectional speculative data mirroring. Shoens may teach speculative data reading, but nothing in the references teaches or suggests speculative data writing or the “send[ing of] data corresponding to at least one write operation to the second storage volume without waiting for feedback regarding the lock operation.” Furthermore, there is no teaching that this speculative writing be performed between two storage volumes and their associated controllers. Therefore, Appellants submit that Claim 12 is patentable on the merits of the arguments set forth above and on the basis of its own further limitations.

[058] Claim 13 simply adds to the limitations of Claim 12 that the apparatus includes a first rollback log and a second rollback log. Therefore, Appellants submit that Claim 13 is also allowable.

**V. The rejection of Claim 11 under 35 U.S.C. §103(a) as obvious in view of Yanai, Shoens and Testardi is improper where Yanai, Shoens and Testardi and the Examiner has not responded to the Applicants arguments.**

[059] Claim 11 was rejected in the first office action mailed December 16, 2005 in view of Shoens, Yanai and U.S. Patent Number 6,973,549 to Testardi et al (hereinafter Testardi). Applicants addressed this rejection in the response mailed March 15, 2006. Appellants reaffirm the arguments made in the response mailed March 15, 2006. Namely, the cited Shoens, Yanai, and Testardi do not disclose or teach a rollback log. Shoens, Yanai, and Testardi also do not teach or disclose the sending of prospective write data prior to the reception of a lock on a target volume. These elements are present in Claim 1 upon which Claim 11 depends.

[060] Appellants submit that since the rejection under 35 USC §112, first paragraph is overcome as explained above and the Examiner has not responded to Applicants arguments in support of Claim 11 that Claim 11 is allowable. Appellants request that the rejection of Claim 11 be overruled.

**SUMMARY**

In view of the foregoing, Appellants respectfully assert that each of the claims on appeal has been improperly rejected because the rejections under 35 U.S.C. §112, first paragraph and §103(a) are improper. Therefore, Appellants respectfully request reversal of the Examiner's rejections under 35 U.S.C. §112, first paragraph and §103(a), and urges that pending claims 1-30 are ready for prompt allowance. Appellants appeal to the Board's objective and reasoned decision on this matter.

Respectfully submitted,

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## **8. CLAIMS APPENDIX**

The claims involved in the appeal, namely Claims 1-30, are listed below.

1. An apparatus for speculative data mirroring, the apparatus comprising:
  - a rollback log configured to receive write data, the write data corresponding to at least one write operation to a storage region within a source volume;
  - a mirror control module configured to initiate a synchronized operation on a corresponding storage region within a target volume; and

the mirror control module further configured to send the write data corresponding to the at least one write operation to the target volume without waiting for feedback regarding the synchronous\_operation on the target volume, wherein the synchronous operation must complete prior to writing the write data to the target volume.
2. The apparatus of claim 1, further comprising a source storage controller operably connected to the source volume and a target storage controller operably connected to the target volume.
3. The apparatus of claim 2, further comprising a transmission link operably connecting the source storage controller to the target storage controller.
4. The apparatus of claim 1, wherein the synchronous operation comprises a lock operation comprising a lock command, and the mirror control module is further configured to send the lock command to a target storage controller operably connected to the target volume.

5. The apparatus of claim 4, wherein the mirror control module is further configured to insert the lock command and the data corresponding to the at least one write operation into the rollback log.
6. The apparatus of claim 4, wherein the mirror control module is further configured to send the lock command and the at least one write operation to the target storage controller and the target storage controller is further configured to repetitively attempt to execute the lock command until the target storage region is locked and to write the data to the target storage region in response to obtaining the lock on the target storage region.
7. The apparatus of claim 5, wherein the mirror control module is further configured to remove the lock command from the rollback log in response to successful execution of the lock operation on the target volume.
8. The apparatus of claim 1, wherein the mirror control module is further configured to remove the data corresponding to the at least one write operation from the rollback log in response to successfully writing the data to the target volume.
9. The apparatus of claim 1, wherein the mirror control module is further configured to halt transmission of the data corresponding to the at least one write operation in response to a rejection of the synchronous operation.
10. The apparatus of claim 9, wherein the mirror control module is further configured to resume transmission of the data corresponding to the at least one write operation in response to subsequent execution of the synchronous operation.

11. The apparatus of claim 1, wherein the mirror control module is further configured to initiate retransmission of the data corresponding to the at least one write operation in response to a rejection of the synchronous operation.
12. An apparatus for bidirectional speculative data mirroring, the apparatus comprising:
  - a first storage control module configured to conduct synchronous storage operations including lock operations on a first storage volume;
  - a second storage control module configured to conduct synchronous storage operations including lock operations on a second storage volume;
  - a first mirror control module configured to initiate a lock operation on a storage region within the second storage volume, the first mirror control module further configured to send data corresponding to at least one write operation to the first storage volume without waiting for feedback regarding the lock operation on the second storage volume; and
  - a second mirror control module configured to initiate a lock operation on a storage region within the first storage volume, the second mirror control module further configured to send data corresponding to at least one write operation to the second storage volume without waiting for feedback regarding the lock operation on the first storage volume.

13. The apparatus of claim 12, wherein the synchronous storage operations comprise a lock operation, and further comprising a first rollback log configured to receive data corresponding to the at least one write operation to the first storage volume and a second rollback log configured to receive data corresponding to the at least one write operation to the second storage volume.
14. A method for speculative data mirroring, the method comprising:
  - inserting data into a rollback log, the data corresponding to a write operation to a storage region within a source volume;
  - initiating a synchronous operation on a corresponding storage region within a target volume; and
  - sending the data corresponding to the write operation to the target volume without waiting for feedback regarding the synchronous operation.
15. The method of claim 14, wherein initiating a synchronous operation comprises sending a lock command to the target volume.
16. The method of claim 14, further comprising removing the data corresponding to the write operation from the rollback log in response to successful execution of the write operation on the target volume.
17. The method of claim 14, wherein inserting data into the rollback log further comprises inserting a lock command into the rollback log.

18. The method of claim 17, further comprising removing the lock command from the rollback log in response to successful execution of the lock command on the target volume.
19. The method of claim 14, further comprising halting transmission of the data corresponding to the write operation in response to rejection of the synchronous operation.
20. The method of claim 19, further comprising resuming transmission of the data stored in the rollback log in response to successful execution of the lock operation.
21. An apparatus for speculative data mirroring, the apparatus comprising:
  - receiving means configured to receive data corresponding to a write operation to a storage region within a source volume;
  - initiating means configured to initiate a synchronous operation on a corresponding storage region within a target volume; and
  - messaging means configured to send the data corresponding to the write operation to the target volume without waiting for feedback regarding the synchronous operation.
22. A system for speculative data mirroring, the system comprising:
  - a source storage controller operably connected to a source volume;
  - a target storage controller operably connected to a target volume;
  - a rollback log configured to receive data corresponding to a write operation to a storage region within the source volume;
  - a storage control module operably connected to the target storage controller, the storage control module configured to initiate a synchronous operation on a corresponding storage region within the target volume.

23. The system of claim 22, where the synchronous operation comprises a lock operation, and further comprising a mirror control module operably connected to the source storage controller, the mirror control module configured to send the data corresponding to the write operation to the target volume prior to receiving acknowledgement of the lock operation.

24. A computer readable storage medium comprising computer readable program code for conducting a method of speculative data mirroring, method comprising:  
receiving into a rollback log data corresponding to a write operation, the write operation directed to a storage region within a source volume;  
initiating a synchronous operation on a corresponding storage region within a target volume; and  
sending the data corresponding to the write operation to the target volume prior to receiving acknowledgement of the synchronous operation.

25. The computer readable storage medium of claim 24, wherein initiating a synchronous operation comprises sending a lock command to the target volume.

26. The computer readable storage medium of claim 24, wherein the method further comprises removing the data corresponding to the write operation from the rollback log in response to successful execution of the write operation on the target volume.

27. The computer readable storage medium of claim 24, wherein inserting data into the rollback log further comprises inserting a lock command into the rollback log.

28. The computer readable storage medium of claim 27, the method further comprising removing the lock command from the rollback log in response to successful execution of the lock command on the target volume.
29. The computer readable storage medium of claim 24, the method further comprising halting transmission of the data corresponding to the write operation in response to rejection of the lock operation.
30. The computer readable storage medium of claim 29, the method further comprising resuming transmission of the data stored in the rollback log in response to successful execution of the lock operation.

## **9. EVIDENCE APPENDIX**

There is no material to be included in the Evidence Appendix.

## **10. RELATED PROCEEDINGS APPENDIX**

There is no material to be included in the Related Proceedings Appendix.